Optical Communications Demonstrator (OCD) Status

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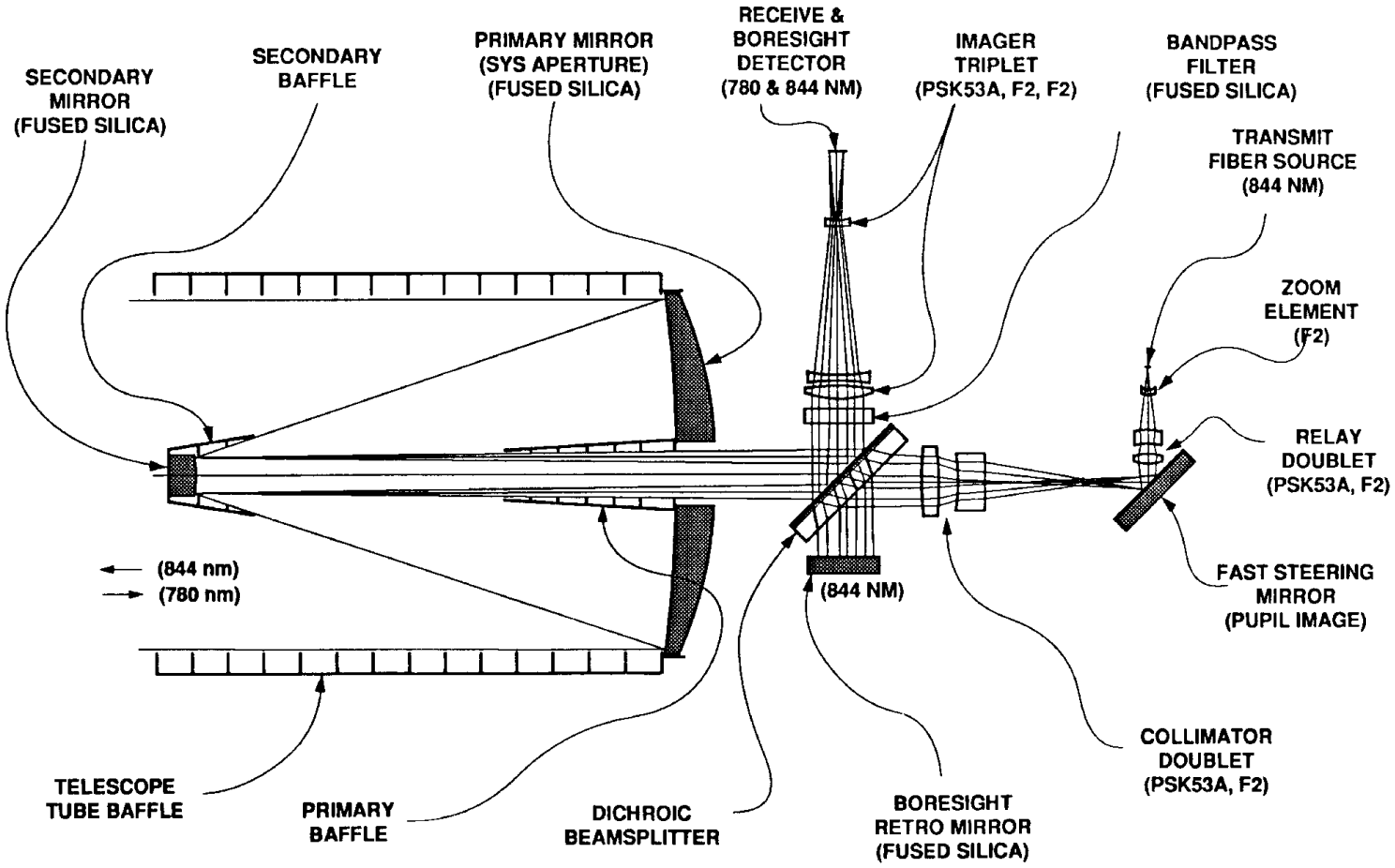
OCD Description

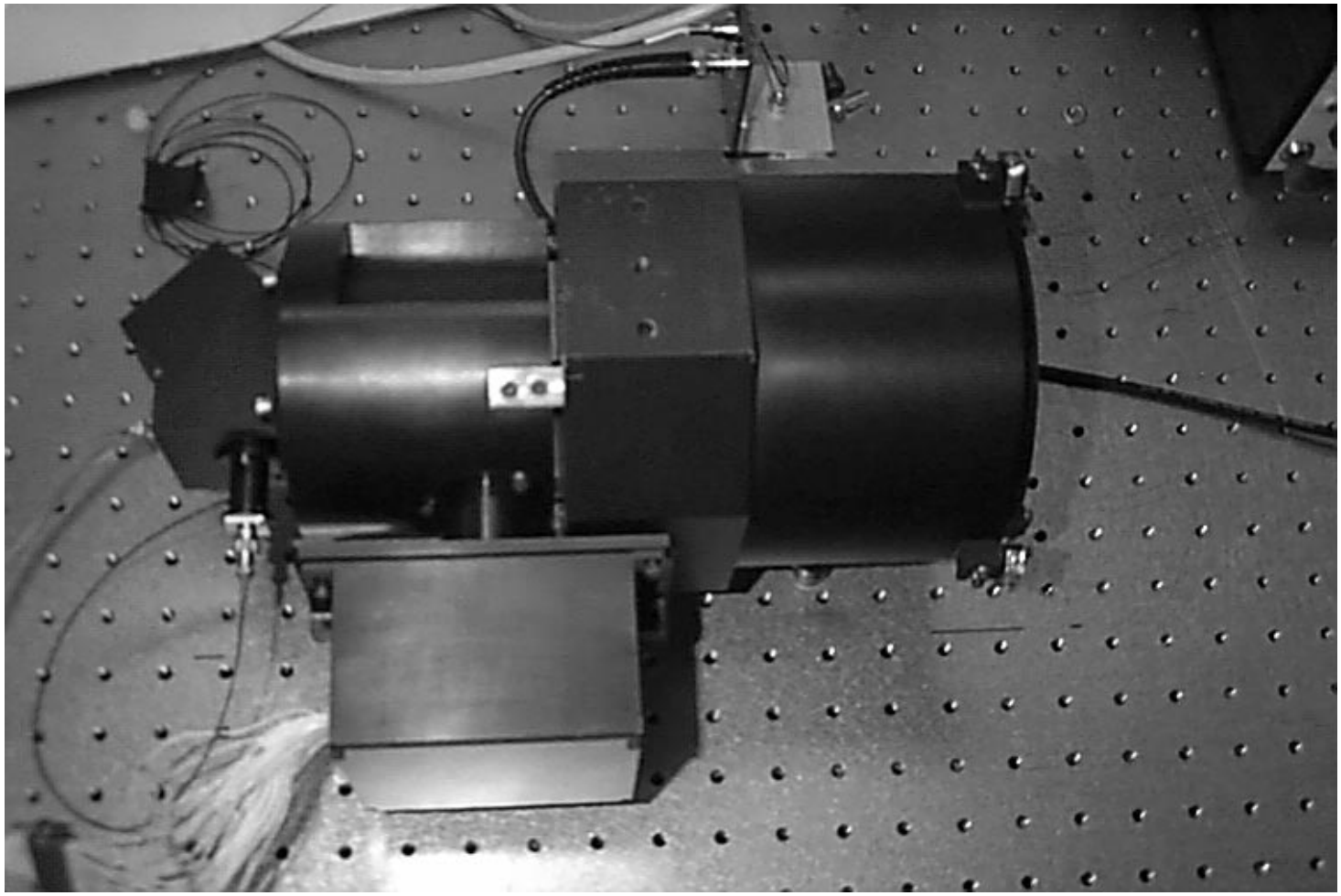
- A laboratory-based lasercomm terminal
  - developed to validate key technologies such as beacon acquisition, precision pointing and high bandwidth tracking
- Reduced complexity architecture
  - OCD uses *one* two-axis fine steering mirror (FSM) and *one* detector array for acquisition, tracking and point ahead monitoring.
  - Fiber-coupled laser provides thermal isolation. Also makes it easy to change lasers for different applications.
  - Terminal built for data-dump from LEO/GEO orbit. Hence there is no communication detector.
  - No redundancy for any components

Optical Design



- Receive at 780 nm and transmit at 840 nm
- 4-inch telescope aperture

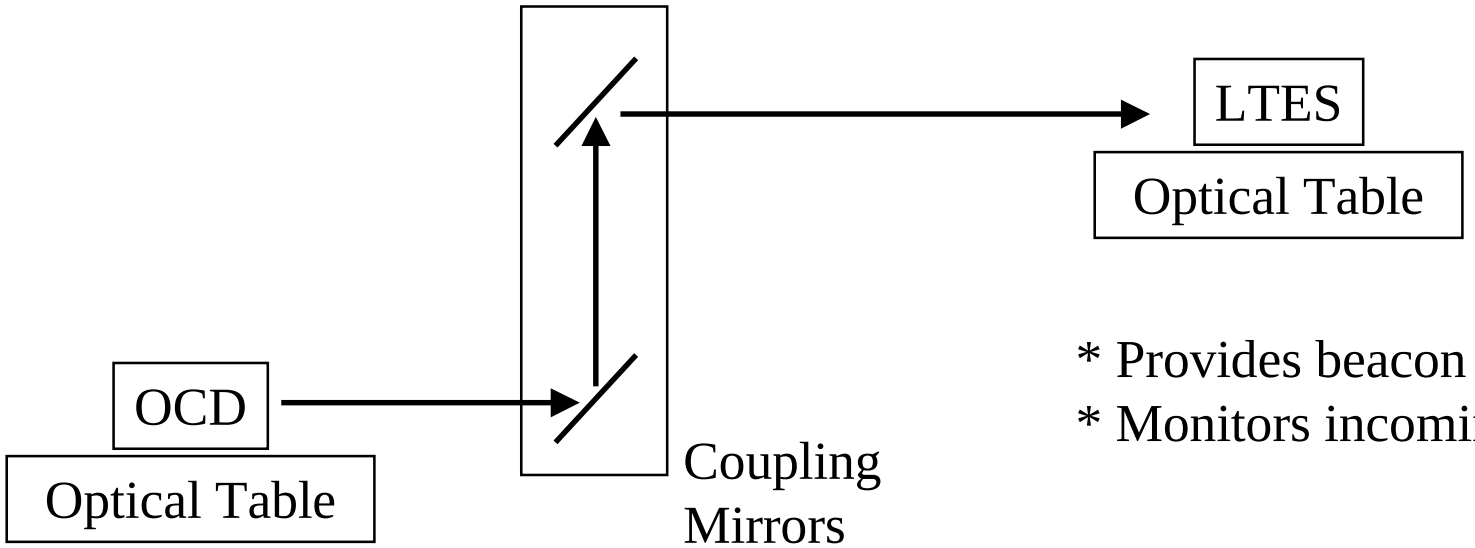
Telescope Optics Assembly



- Assembly and alignment completed with Zygo interferometer

Characterization

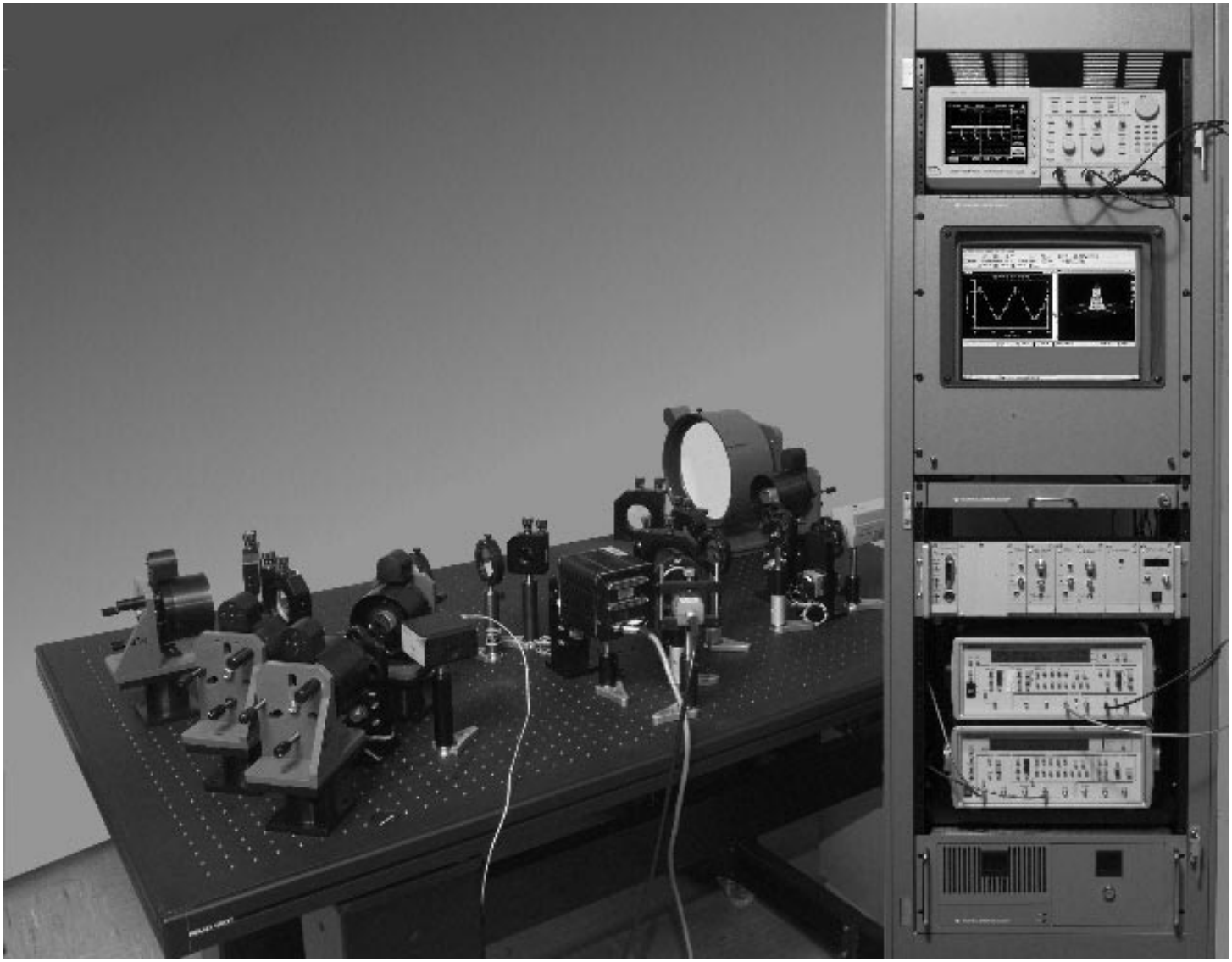
- With Lasercomm Test and Evaluation Station (LTES)



* Provides beacon
* Monitors incoming beam

* Tracks beacon
* Sends data

LTES



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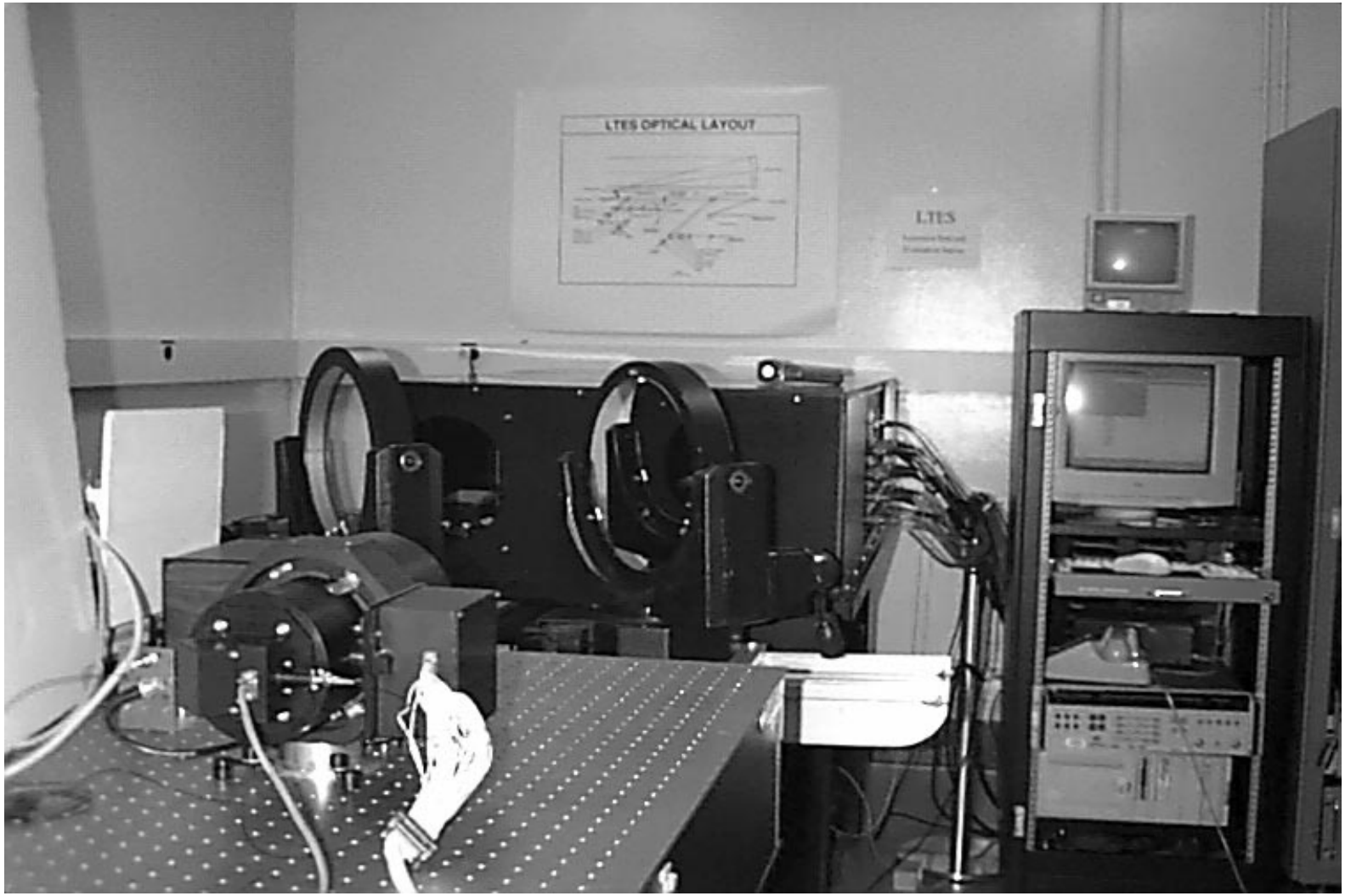
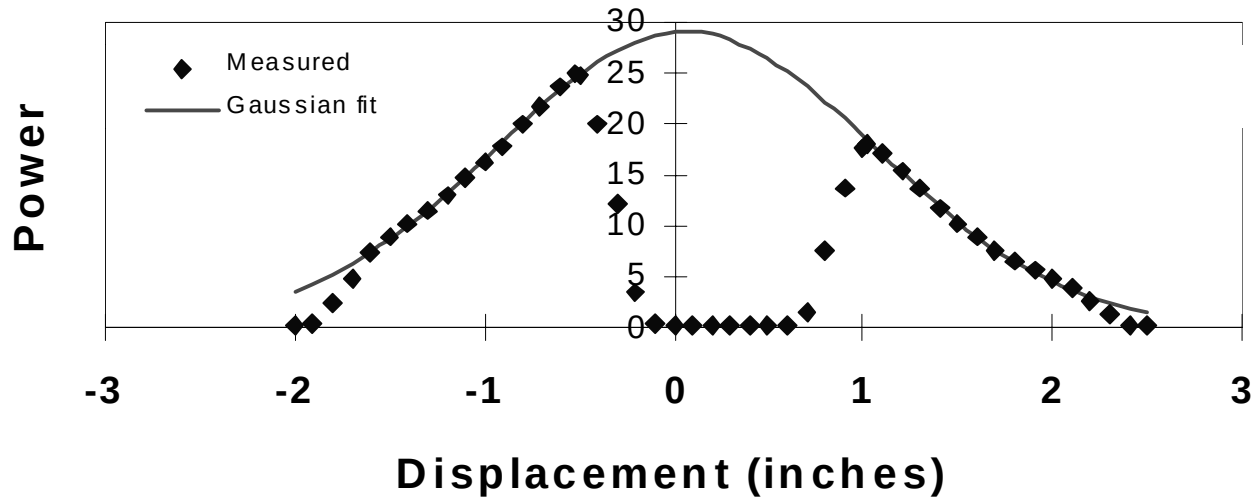
Characterization



Transmit Channel

- Efficiency:
  - 40% measured (42% expected)
  - ~25% power lost due to obscuration and truncation
- Output Beam Profile (Near Field):
  - Nearly optimum for given aperture size and obscuration



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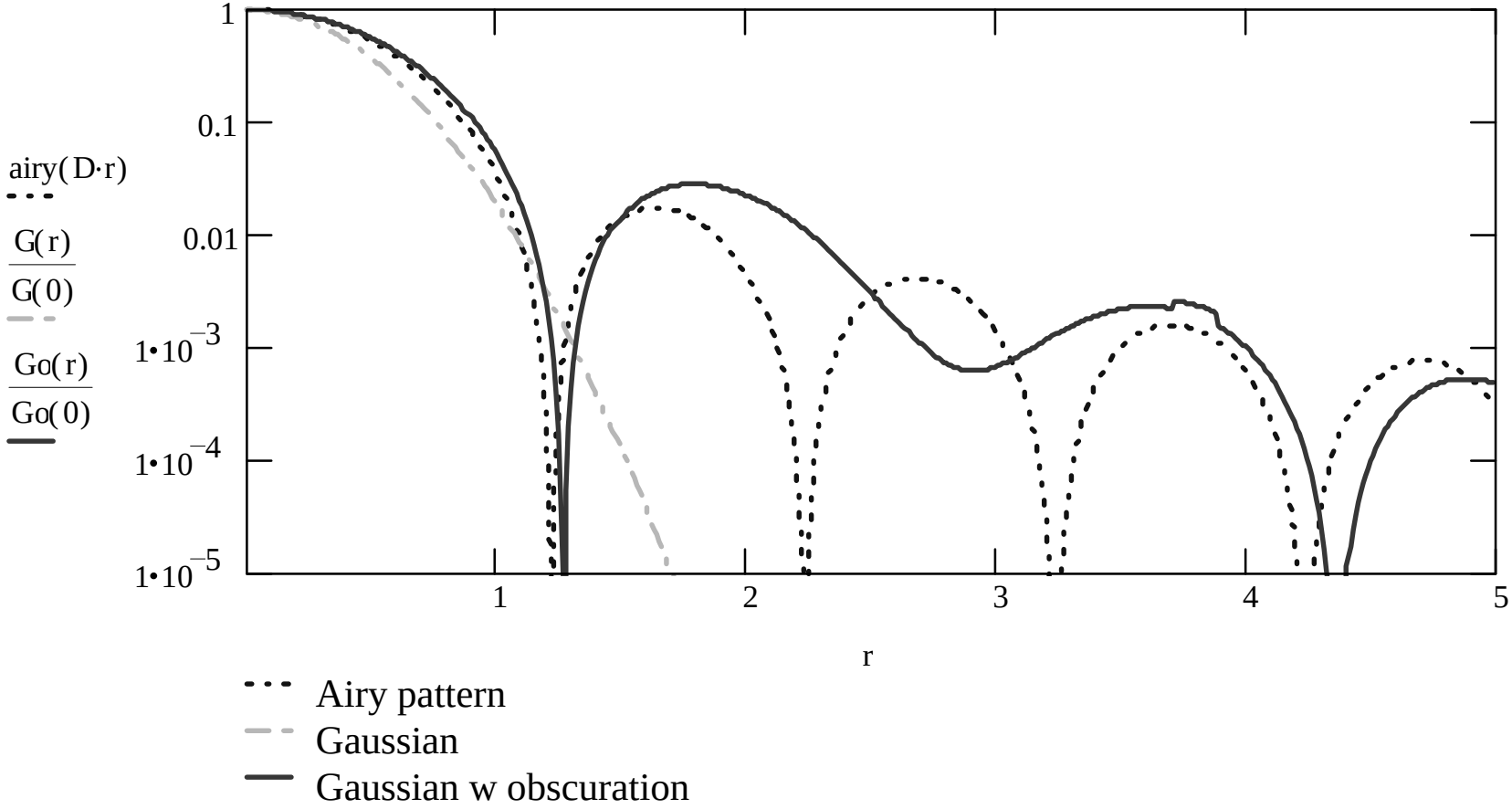
Transmit Channel

- Expected Far-field Pattern



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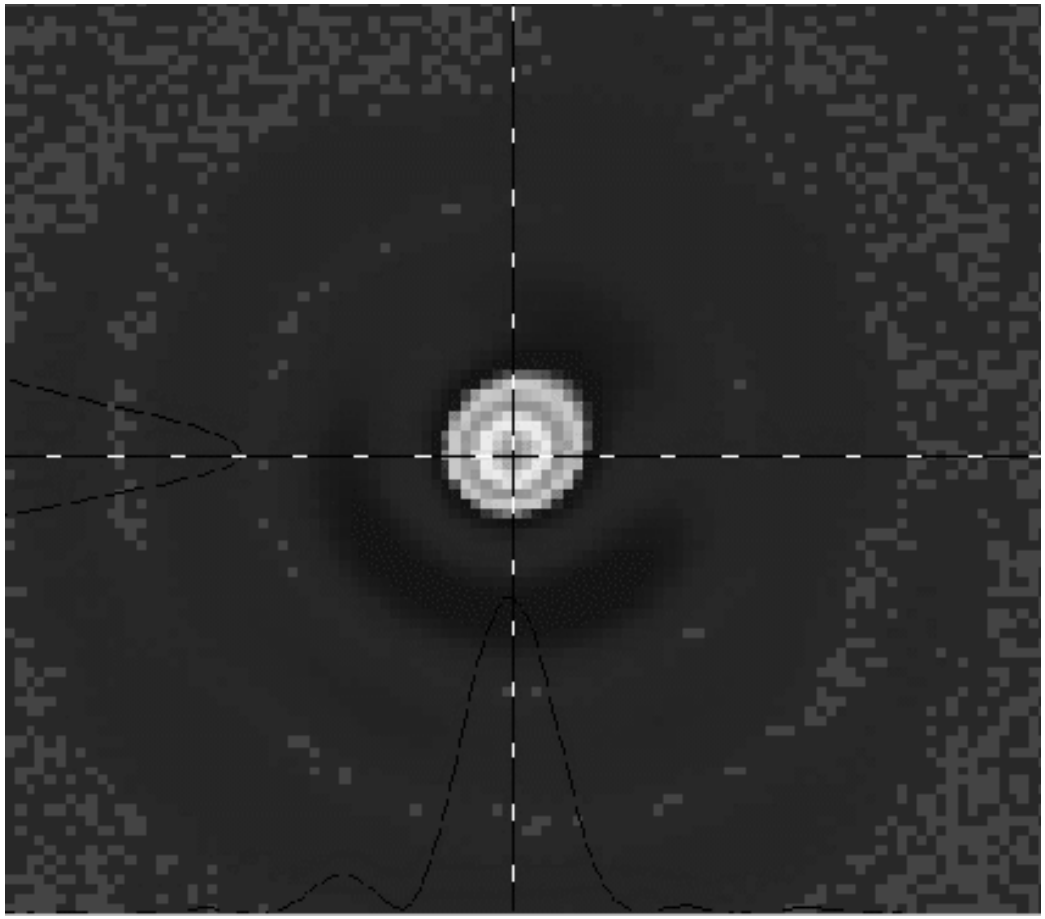
Transmit Channel

- Measured Far-field Pattern



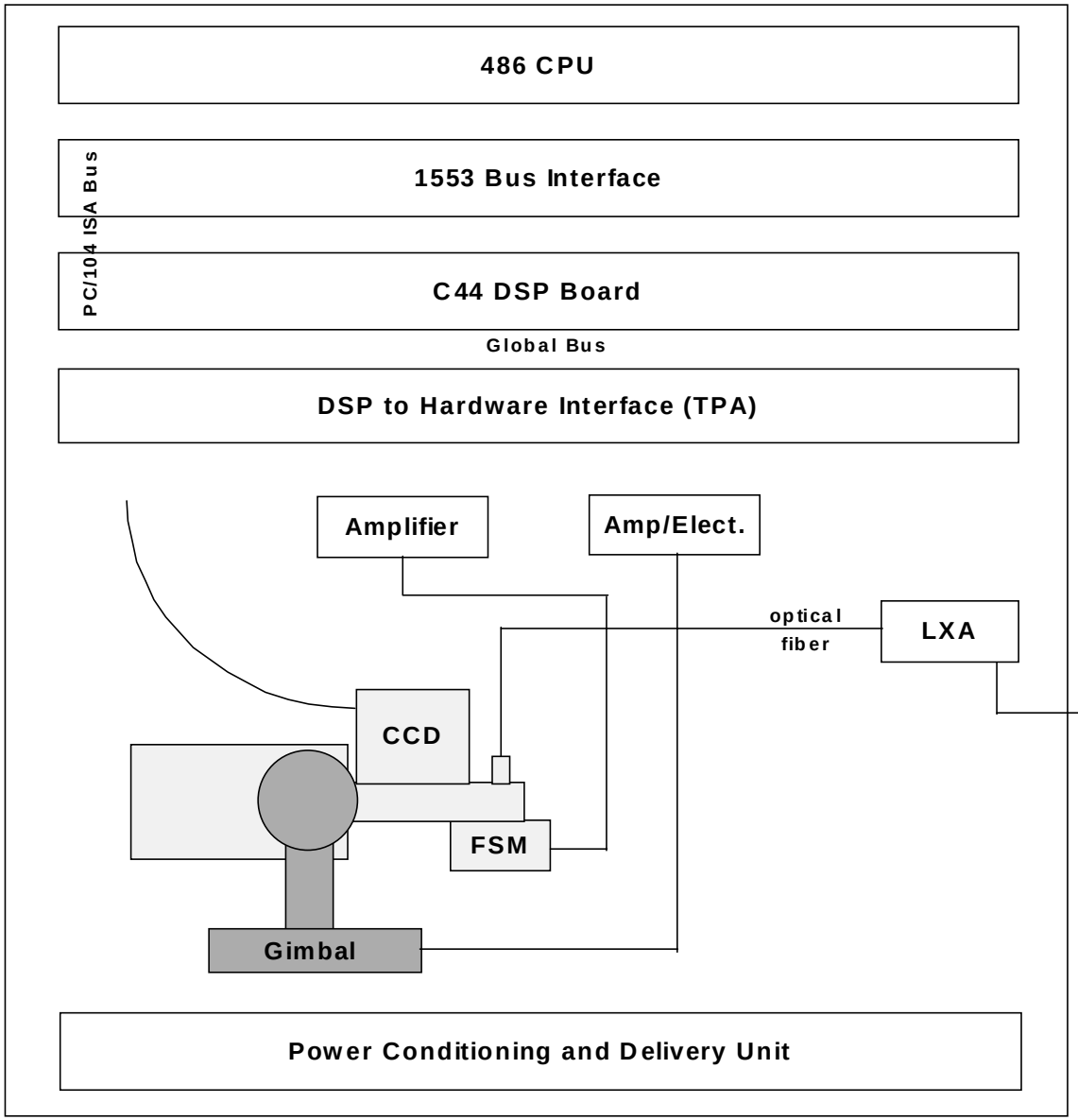
Receive & Boresight Channels

- Beacon Tracking Channel:
  - 65% transmission expected
  - CCD Sensitivity is about 1 nW for 500 μs exposure
  - ~20 pW/cm^2 intensity required in front of OCD aperture
- Boresight Channel:
  - efficiency = 1.2 x 10^{-6} (or about 60 dB of attenuation)
  - 1 mW fiber output power produces 1 nW at detector
    - enough to properly illuminate CCD
  - Need another ~16 dB attenuation for use with higher power (30 mW average) laser. Possible through
    - AR coated retro mirror or
    - highly transmissive dichroic beam splitter

Acq/Trk

- Acquisition and tracking implemented and tested on a separate setup
  - ~ 1 sec acquisition time when beacon is in CCD FOV
  - tracking bandwidth > 100 Hz with 2 kHz frame rate
  - acq/trk processing done using C40 DSP board
- Acq/Trk implemented and testing started on OCD with beacon from LTES
  - Detailed characterization planned in coming weeks

Electronics



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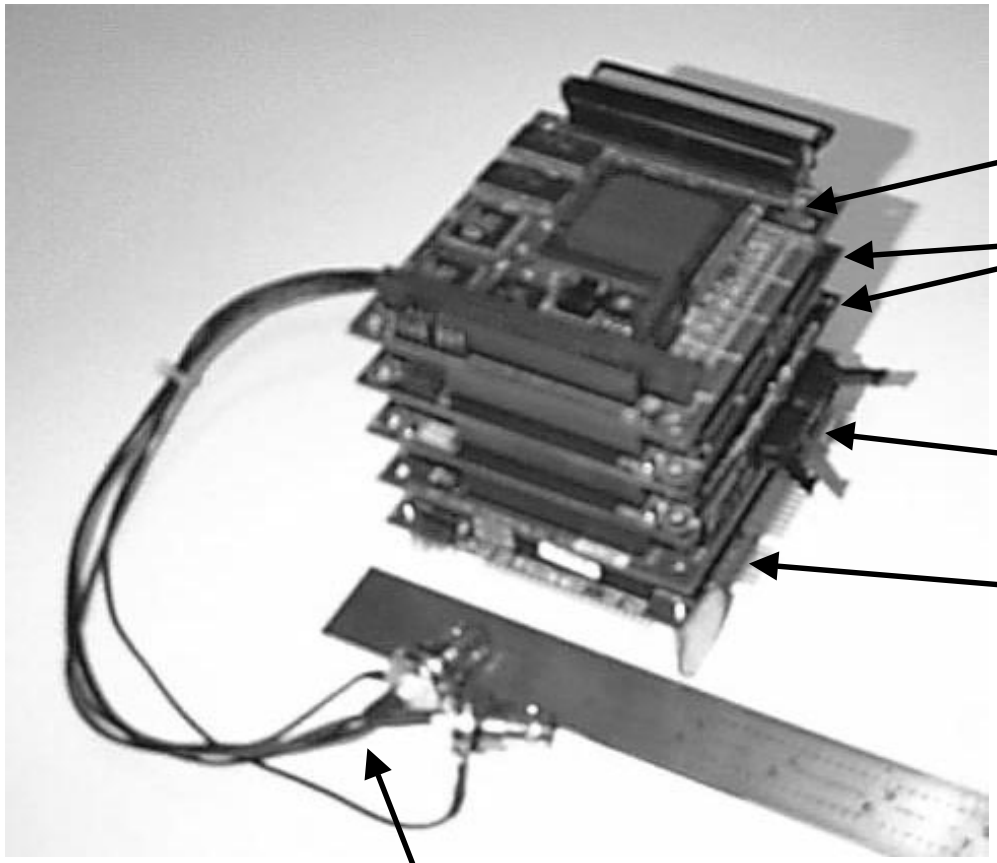
PC/104 Architecture

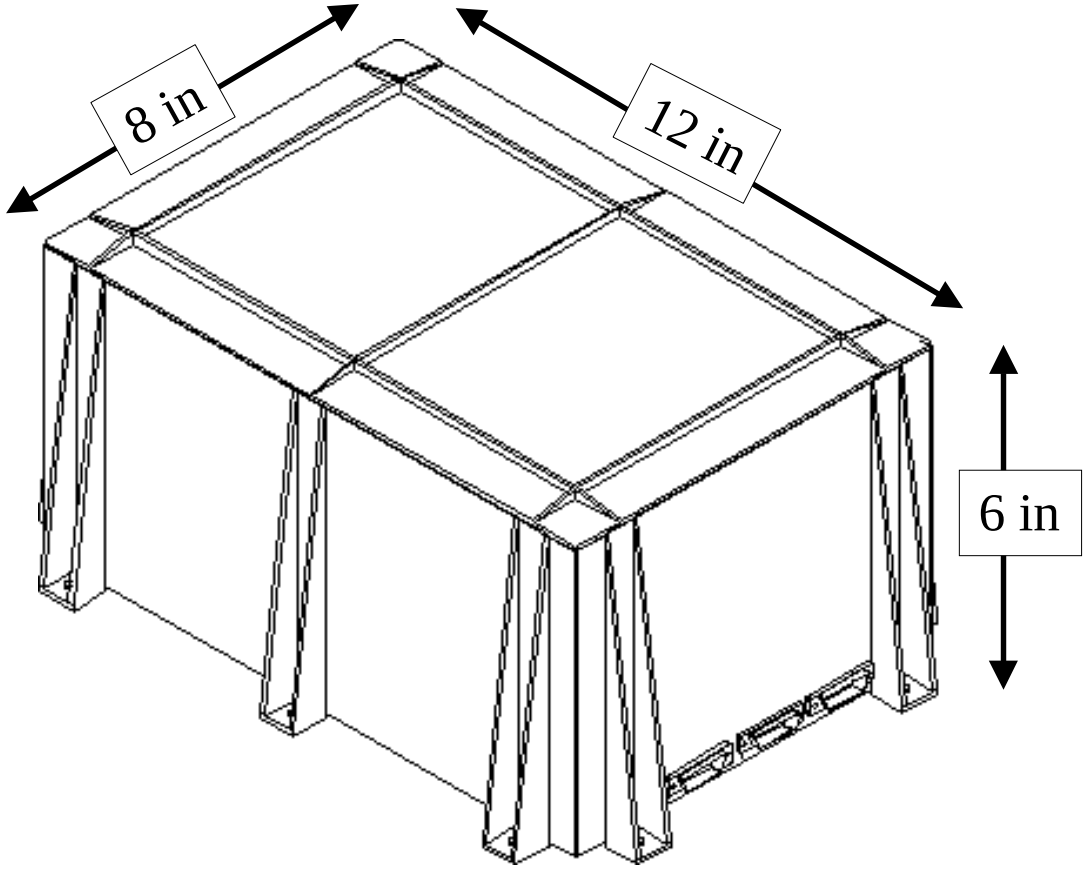
- A PC with different form factor (i.e. same signals)
- 3.6 in x 3.8 in cards
  - small size and weight
- Low power
  - each card typically uses less than 5 W
- Stack through bus (no backplane)
- Commercially available for embedded controller applications
  - Conforms to the IEEE-P996 specification

PC/104 Stack


C44 DSP Card
TPA Cards
MIL-STD-1553B Card
486 CPU Card
Cable to 1553 bus

Electronics Enclosure

- Includes PC/104 stack, gimbal & FSM amplifiers, interpolators and DC-DC converters

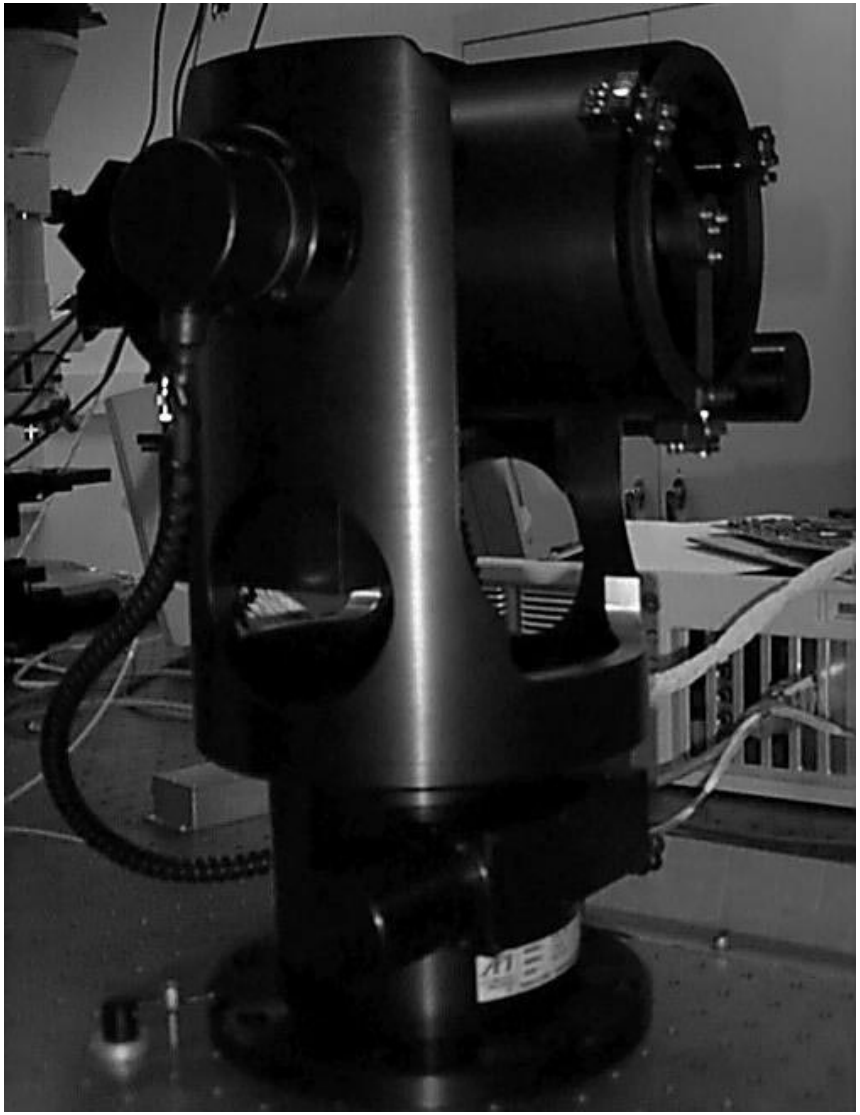


J. De Pew, 1998

Fully Assembled OCD

- Total mass less than 25 kgs
  - TOA: 5.6 kg
  - Gimbal: 10 kg
  - Electronics & cabling: < 10 kg
- Power consumption ~50 W average
  - Peak power significantly higher when gimbal driven hard
- Only three external connections
  - 28 V DC power supply
  - 1553 bus interface
  - High speed data input for laser modulator

Fully Assembled OCD



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Future plans

- Complete acq/trk performance tests and analyses
- Complete PC/104 electronic packaging
- Do environmental (thermal/vac/shake) tests
- Field test unit in a ground-ground demo (FY'98)
- Use terminal in an air-ground demo (FY'99)

- Transfer results of OCD development to a proto-flight development terminal

Acknowledgements

- A. Biswas — LTES support & laser characterization
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